The Great Indian Famine of 1899.

When, in a sun-spot cycle, the solar temperature is more than usually increased, the regularity of the above effects is liable to be broken, as the advent of the – pulse is retarded.

This, as we have already pointed out, is precisely what happened after the abnormal + heat pulse of 1892, following close upon the condition of solar mean temperature.

The widened line curves, instead of crossing, according to the few precedents we have, in 1897 or 1898, have not crossed yet—that is, the condition of ordinary solar mean temperature has not even yet been reached.

We have shown that, as a matter of fact, in a normal cycle India is supplied from the southern ocean during the minimum sun-spot period, and that this rain is due to some pressure effect brought about in high southern latitudes by the sun at – temperature.

As the – temperature condition was not reached in 1899, as it would have been in a normal year, the rain failed (Fig. 3).

We may say then that the only abnormal famine recorded since 1836 occurred precisely at the time when an abnormal effect of an unprecedented maximum of solar temperature was revealed by the study of the widened lines.

TABLE

Showing the Occurrence of the + and – Rainfall Pulses in other parts of the World.

	+ 1870	– 1877	+ 1882	– 1886	+ 1892
Batavia ...	—	1876	1882	1888	(?)
Mauritius ...	—	1877	1882	1888	1892
Catherinenburg (Russia)	—	1877	abs.	1887-8	1892
Scotland ...	—	1877	—	—	1892
Copenhagen ...	1872-3	1877	1882	1888	1891
Adelaide ...	1870	1877	1883	1889	1892-3
Tifilis	1870	1878	1881	1886-90	1893
Archangel ...	1872	1878	1881-2	1887-8	1892
Brussels ...	—	1878	1882	1888	1892
Hobart Town ...	—	1878	1882	1887	1893
Malabar[1] ...	1871	1878	1882	1888	1892
Toronto ...	1870	1878	1883	1886	1893
Cordoba (Arg.)	—	1878	1883	1888	1892
Cape	—	1878	1883	1888	1892
Java	1872	1879	1882	—	1893
Barnaul (Russia)	1872	1879	1882-3	1887	1894
St. Petersburg	1871	1879	1883	1888-9	1893
Nile	1871	1879	1883-4	—	1893-5

[1] For comparison.

THE BRADFORD MUNICIPAL TECHNICAL COLLEGE.

PROF RÜCKER recently distributed the prizes at the Technical College at Bradford, which was taken over by the municipality a year ago, and is now controlled by a Committee of the City Council. The following is an abstract of his address:—

It would be trite to dwell at length on the changes which have taken place in the educational standards during the last quarter of a century. Then Mr Forster's Education Bill had only been in operation for five years. Now we have free elementary education, and a large sum has been provided for technical education. Two new Universities have been founded and a third, after fifty years' examining, is at length about to teach. Education is not now regarded as the task of a few dons and professors and schoolmasters. It is a matter which the Cabinet discusses, together with the issues of peace and war, and with the federation of daughter States into a Commonwealth. Nay, and in the great spread of local self-government, when Town Councils decide questions which affect more people than constituted, in the beginning of the century, many an independent German State, education is not forgotten; and here in Bradford you have the whole authority and power of your great municipality brought to bear to form a technical school which will support the industries on which your prosperity depends.

And yet, gentlemen, in the midst of all this eager and fruitful effort how difficult it is to decide what the ideal system of education should be. For in any such system two things must be considered, the welfare of the individuals taught and the welfare of the community of which they are a part; and at first sight these two do not always seem to be identical. Each man, the State may say, has a task to perform, which, if he performs it well, is for the good of the community, and, provided he is a good citizen, I care only about his special task. This man may have to dispense justice. My only concern is that he should be a just and learned judge. That man is to be a manufacturer. If he manufactures well, that is all the State need care for. But surely this view only needs stating clearly to show that there must be a fallacy somewhere. Like the old political economy, it assumes that man lives by bread alone. At the best he cannot always be working, and his own happiness—aye, and the good of the State, too—may be affected by whether his amusements are refined or low, upon whether they elevate or debase him. From this point of view the best educators would be insects, which, like ants or bees, have developed special forms of workers, or soldiers, or drones; or even, as is, I believe, the habit of one species, use an individual to store their food till it becomes a mere bloated honey-bag.

Others hold the opposing view. The object of education, they say, is to educate—that is, to bring out the latent capacities of the mind. Provided this end is achieved, it matters little how this is done; but, on the whole, it is better that the subjects taught should be selected rather because they illustrate general principles than because they are likely to be immediately useful. This ideal is to be condemned because it is impracticable for all but the few. It never has been the system adopted for the working man, and has been very imperfectly adopted for the great bulk of the commercial and professional classes. In the stress and struggle of modern life it is becoming more and more difficult to adopt it for anybody, and common sense revolts against the idea that the utility of the subject taught, or of the method of teaching it, is of secondary importance.

We come, then, to the conclusion that the truth lies somewhere between these two extremes, and that the best education is that which will prepare a man for his walk in life, and will also, as far as may be, keep his mind open to interests and ideas other than those upon which his success as a bread-winner directly depends.

I will not attempt, in the short time at my disposal, to sketch out a general system of education in which these conditions would be fulfilled, and, if I did, I should throughout be conscious that I was only throwing an apple of discord among educational experts.

But, taking scientific and technical education as a whole, I am clear that for the better students, at all events, the study of science should be relieved and aided by the study of modern languages.

Nowadays everything is becoming more cosmopolitan. Science is becoming more international. Only this summer I attended the first meeting of a new association of all the great scientific academies of the world. Again, with the new century will begin the publication of an international catalogue of scientific literature, in which all scientific memoirs and publications will be catalogued.

I quote these instances as they are those which have fallen more immediately under my own observation, but manufacturers can tell a similar tale. The visit of the Iron and Steel Institute and of the Institution of Electrical Engineers to Paris, the visit of the Electrical Engineers to Switzerland, and the travels of the Naval Architects all show that the great professions are becoming more and more international. It is essential that a young man who intends to keep abreast of what is being done abroad should be prepared to read foreign periodicals, and to make the most of any opportunity which may occur of going abroad himself. To do this he must study modern languages. This will be directly useful, and it will also have the great educational advantage that it tends to keep alive an interest in something other than the science or technology to which I am supposing that the attention of the student is chiefly turned.

As matters stand at present, a number of the most intelligent of our youth, after the more elementary parts of their education are completed, devote themselves chiefly to science. Many of the best of them come under my personal observation in the Royal College of Science. Some of them develop such marked scientific ability that they pursue the more theoretical side of their studies, and aim at taking a degree with honours. Their education has often been carried on chiefly by means of State or municipal grants made to the schools or colleges in which they have been educated. In the system of education under which they have been brought up, no effort has been made to induce them to study classics. Yet when they have proved themselves worthy of a high University training in science, they are suddenly stopped in the middle of their career, and told that no further progress towards a degree is possible unless they go back to school again and learn the Latin grammar. I think that the time has come when this should be changed, and a knowledge of modern languages should be allowed to replace Latin.

The hard and fast line of separation which has too often been drawn between the earlier education of those who do and of those who do not propose to go to the University would thus be obliterated. Both should be taught modern languages, both should be taught science, and both would then have acquired a literary and scientific training which could be developed in the further stages of a technical or a University education.

Do not misunderstand me. I am not advocating the abolition of the system of classical education which is predominant in the public schools. But it is too often forgotten that there is another great system of education growing up side by side with that which is based on classics. This system is based on a knowledge of science. The study of classics is introduced into it neither at the beginning as a foundation nor at the end to complete it. It is introduced as a patch in the middle. Of two things one. If Latin is essential, let the State and the municipalities supply funds for it as lavishly as they do for science. If it is not essential, do not insist on introducing it at the most inconvenient moment of the student's career.

But if I would take away something from the burden now laid on beginners, I would also modify the later stages of scientific or technical education.

Up to the present the general training of students of science at the University has ceased with their matriculation. The modicum of Latin which they have then obtained, with a little history and geography, and perhaps some French, is abandoned. The University takes no further note of their progress in these subjects. If I am in favour of ceasing to make Latin compulsory, I also desire that the more advanced students of science or industry should carry on the study of modern languages, which should be regarded as an integral part of a scientific education. Too exclusive attention to one subject would thus be less probable; but nevertheless the student would be directed to what he himself would regard as matter germane to the central interest of his life, for a knowledge of French and German is essential to the proper cultivation of science. These views I have long held, and I am glad to learn that they are very similar to, if not identical with, the views of Lord Rosebery. If the politicians determine on the reform it will become a practical question.

But though anxious that this reform should take place, I am well aware that the matter of immediate, pressing and vital importance for our national welfare is that the knowledge of science should not only be more widely spread among us, but also that the scientific method should be more widely applied to industry.

I have no intention of attempting to read Bradford a lesson on business methods. But you will allow me to congratulate both the scientific and the business worlds on the fact that they are drawing nearer together. A profound knowledge of the secrets of nature may be combined with knowledge of the world, while the business man is often a highly cultivated scholar, and is learning the lesson that he who is quickest to apply new knowledge to old problems is most likely to win and to keep the markets of the world.

Day by day the workshops are growing more and more like scientific laboratories, except that the appliances are on a scale which few laboratories have the means to command. On the other hand, the laboratories are becoming more and more like the homes of scientific industry.

Germany has for some years had a national physical laboratory—the Reichsanstalt—in which scientific questions likely to be useful to industry are investigated. The organisation for which that country is remarkable, and in which we are deficient, was shown by the way in which the scientific exhibits at the Paris Exhibition were dealt with. Those of our scientific instrument makers who sent specimens of their work, each selected and exhibited what seemed to him good. Their exhibits were distinct and separate, and the English exhibit as a whole was a patchwork, with no well-defined scheme or pattern. In Germany the scientific exhibit was supervised by the officials of the Reichsanstalt. Instruments of the same class were exhibited together, whoever their maker might be; and the visitor could see at a glance the best that Germany could produce of each particular type. Assistants were ready to open the cases and to display the wares. Catalogues of the different firms were furnished if the visitor signed a written request, and a central office had been established where orders could be booked. This, of course, was an exceptional piece of work, but the general uses of a national laboratory are permanent; and, owing to the efforts of the British Association and the Royal Society, the Government have lately asked the Royal Society to undertake the management of an institution similar to the Reichsanstalt. The sum granted is very small, as compared with the resources of the German institution, but I do not quarrel with that decision. If the thing is good it will grow, and it is perhaps better not to begin on too large a scale. A year ago we were ready to get to work. Six of the great technical societies are represented on the governing body. Committees have formulated a scheme of work, but grave delay has been occasioned by opposition to the erection of the laboratory at Richmond.

But, gentlemen, putting our difficulties aside, I believe that the foundation of a National Physical Laboratory, and the establishment of a municipal technical school at Bradford are both signs of the growing recognition of the ties between science and industry; and I take it as another sign of the same fact that the heads of this great technical college have asked me, a student of pure science, to distribute your prizes to-night. I should be misusing the opportunity you have given me if I did not assert the conviction, common both to you and me, that it is by means of the scientific study of various industries, study such as you here carry on, and such as will be carried on in the National Physical Laboratory, that trade and science alike will prosper.

The first nuggets in gold-bearing districts are often picked up upon the surface; but mines can only be worked on a large scale by organised industry. As we penetrate deeper into the secrets of nature, as the industrial struggle grows keener, the rough and ready methods of the past will not win either knowledge or wealth.

We cannot afford to dispense with the old virtues. If we become slack and idle, if we devote to sports, innocent and useful in their place, the energy and attention which others are giving, not to the amusements, but to the business of life, we shall be, as we shall deserve to be, beaten. But to the old virtues we must add new methods, and among these none seems to me more praiseworthy than that a great municipality should determine that the lads who embark on the principle industries of the town shall have an opportunity of mastering the scientific principles on which those industries are based, and shall be shown, as they master them, how the principles are to be applied to the business of life.

THE ALLIANCE BETWEEN SCIENCE AND INDUSTRY.

LAST September Prof. Carhardt communicated to the American Institute of Electrical Engineers a very complete account, which has recently been printed in *Science*, of the Reichsanstalt at Berlin. He had worked there as a guest for some months in 1899, and had thus gained an insight into its management and organisation. The details he gives of these are very interesting, and the proof of the value of the work done, and of its consequences to German industry, most striking. The cost of the Institution, we may note, was about 200,000*l.*; the annual expenditure amounts to about 15,000*l.* After mentioning these figures he continues, "A very pertinent inquiry is, what are the results of all this expenditure?" and a careful analysis leads him to the conclusion that, "The results have already justified, in a remarkable manner, all the expenditure of labour and money. The renown in exact scientific measurements formerly possessed by France and England has now largely been transferred to Germany. Formerly scientific workers in the United States looked to England for exact standards, especially in the department of electricity, now they go to Germany." And again, "Germany is rapidly moving toward industrial supremacy in Europe. One of the most potent factors in this notable advance is the perfected alliance between science and commerce existing in Germany. Science has come to be regarded there as a commercial factor. If England is losing her supremacy in manufactures and in commerce, as many claim, it is because of English conservatism and the failure to utilise to the fullest extent the lessons taught by science."

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held as usual on St. Andrew's Day, November 30, in the apartments of the Society at Burlington House. The auditors of the treasurer's accounts having read their report, and the secretary having read the list of Fellows elected and deceased since the last anniversary, the president (Lord Lister) proceeded to deliver the anniversary address. After referring to the losses by death sustained by the Society since the previous anniversary, and briefly noticing the work and careers of the deceased Fellows, the president continued his address as follows:—

Through the Malaria Committee the Society has kept in touch with the progress that has been made in unravelling the mystery of the greatest scourge of our tropical colonies, and with the steps that advancing knowledge has suggested for its suppression. The subject has now reached a stage at which it may be not unfitting to refer briefly to what has been accomplished.

The term "malaria" implied the belief that some vitiated state of the atmosphere was the cause of the disease. But the knowledge gained of late years of the parasitic nature of infective disorders pointed clearly to such an origin of the intermittent fevers, as the various manifestations of malaria have been termed. Accordingly diligent and long-continued search was made in the water and the soil of malarious districts in Italy for the suspected living agent, but without success. The discovery was made in 1880 by Laveran, a French army surgeon stationed in Algiers, who observed in the red blood corpuscles of malarious patients what he regarded as adventitious living organisms; not of vegetable nature like the bacteria which constitute the *materies morbi* of so many infective diseases, but a very low form of animal life. In what he believed to be the youngest condition of the organisms, they appeared in the red blood-discs as tiny specks of colourless protoplasm, possessing amœboid movements. These, growing at the expense of the red corpuscles which they inhabited, consumed them more or less completely, at the same time depositing in their own substance a peculiar form of dark brown or black pigment, such as had long been known to form characteristic deposits in the organs of malarious subjects. As they grew they assumed various forms, among which was what Laveran termed the "rosace," a rounded body bearing at its circumference little spherules, while the pigment was accumulated at the centre (*vide* Laveran, Du Paludism, Paris, 1891).

This discovery of Laveran's, at first regarded with the gravest suspicion by pathologists, was the first great step in the etiology of malaria. It supplied the means of distinguishing the disease from its counterfeits, and it explained the wonderful specific efficacy of quinine, till then given only empirically. Quinine is remarkable in the circumstance that it acts with deadly effect upon some microbes, in dilutions which are quite unirritating to the human tissues. It can thus be given in sufficient doses to kill the malaria parasite in the blood without injuring the patient.

Nine years after Laveran's discovery, Golgi, of Pavia, who had been specially studying the "rosace" form of the parasite, and who had become convinced that the spherules at the circumference of the rosace were sporules of the microbe, announced that he had observed differences between the rosaces of the tertian and quartan forms of the fever so great and so constant as to make him satisfied that they were two distinct species of organism. At the same time he had made the extremely important observation that the periods of occurrence of the fever corresponded with the times of maturation of the rosaces. These, all coming to maturity about the same time, shed their sporules into the blood, and this determined the febrile attack. The free sporules then, according to his view, attached themselves severally to other red discs, constituting Laveran's tiny amœbæ, and grew in the red copuscles without causing symptoms till they had produced a fresh crop of sporules ripe for extrusion, the time for this being two days in the tertian and three days in the quartan form. Thus the periodicity of the intermittent fevers and their variety in that respect were alike explained. (*Vide* Laveran, *op. cit.*)

A few months later a third species of the parasite was recognised, having the peculiarity that some of its individuals, instead of being of rounded form, were of crescentic shape. This species received the title æstivo-autumnal, on account of the season in which it showed itself in Italy. It was not so regular in its periods as the others, and was much more dangerous. The existence of these different species was at first very generally doubted, but it is now universally accepted and is of very great importance. The examination of a drop of blood from the finger of the patient enables the physician to decide, not only whether the disease is malaria, but which of the three types it will follow. The more dangerous crescent form is commonest in the tropics, and hence has been termed by Koch